299-E33-19

Log Data Report

Borehole Information:

Borehole: 299-E33-19			Site: 216-B-11A Injection Well		
Coordinates		GWL (ft)[1]:	231.9 ft	GWL Date:	04/90
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
137,422.86	573,847.84	06/56	638.72	252.0	cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
carbon steel	2.0	8.64	8.0	0.322	0	249

Borehole Notes:

The borehole and casing information provided above is derived from *Hanford Wells* (Chamness and Merz 1993). The depth information is referenced to the top of casing that in the past (i.e., 1993) was about 2 ft above ground surface. At the time of logging, casing stickup was measured at 4.3 ft above ground surface and was the zero reference for logging. It is not known if casing was added or the ground surface has been lowered causing the discrepancy. Therefore, the logging depth may not match the depths from previous logs provided above and should be adjusted upward 2.3 ft. The 8-in.-inside diameter (ID) casing is assumed to be 0.322 in. thick. This value is the published thickness for ASTM schedule-40 steel pipe, a common casing material. It is reported that the casing was perforated from 217 to 248 ft with five perforations per foot.

Logging Equipment Information:

Logging System:	Gamma 2B		Type:	SGLS (35%)
Calibration Date:	09/00	Calibration Reference:		09/00
		Logging Procedure:		MAC-HGLP 1.6.5

Log Run Information:

Log Run	1	2	3		
Date	06/25/01	06/26/01	06/27/01		
Logging Engineer	Musial	Musial	Musial		
Start Depth	249.0	132.5	61.5		
Finish Depth	131.5	35.5	4.5		
Count Time (sec)	100	100	100		
Live/Real	L	L	L		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	0.5	0.5		
ft/min	n/a	n/a	n/a		
Pre-Verification	B0007CAB	B0008CAB	B0009CAB		
Start File	B0007000	B0008000	B0009000		
Finish File	B0007235	B0008194	B0009113		

Log Run	1	2	3		
Post-Verification	B0007CAA	B0008CAA	B0009CAA		

Logging Operation Notes:

Logging occurred on three separate days in a single casing configuration. Data were collected from 35.5 to 61.5 ft in log runs 2 and 3 that were used as a repeat section to demonstrate logging tool performance.

Analysis Notes:

Analyst:	Henwood	Date:	08/13/01	Reference:	MAC-VZCP 1.7.9 Rev. 2

Pre-run and post-run verification of the logging tool were performed for each day's log event. The post-run verification for log run 1 and the pre-run verification for log run 3 failed at least one of the acceptance criteria. The peak counts per second for the 2614-keV peak was below the lower control limit for log run 1 and the full-width-half-maximum control limit was exceeded in both of the failed verification data. Examination of spectra indicates the detector appears to be functioning normally and the log data are provisionally accepted. The pre-verification spectra collected during log runs 1 and 2 and the post-verification for log run 3 were used for the energy and resolution calibration for the data processing.

Each spectrum collected during a log run was processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL using an efficiency function and corrections for casing and dead time established during calibration of the logging system.

Log Plot Notes:

Separate log plots are provided for man-made radionuclides (^{137}Cs and ^{60}Co), naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U [KUT]), a combination of man-made, KUT, total gamma and dead time, and repeat logs. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable limit (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing corrections. These errors are discussed in the calibration report.

In the combination plot, dead time is included. Concentrations of all radionuclides in depth intervals where the dead time exceeds about 40% may be underestimated slightly. The maximum dead time encountered was less than 2% percent in which case no dead time correction is applied.

Repeat log plots at a selected depth interval for man-made and KUT concentrations and total gamma counts (uncorrected for dead time or casing) are also included. The repeat plots indicate good agreement between successive log runs except for the ^{238}U concentrations, demonstrating good repeatability in both depth and measurement.

Results and Interpretations:

^{137}Cs and ^{60}Co were detected in this borehole. ^{137}Cs was detected between about 5 and 15 ft, at 109 ft, and between 230 and 249 ft in depth. The highest ^{137}Cs concentration measured about 90 pCi/g at 14.5 ft. ^{60}Co is measured at about 120 ft and near the bottom of the borehole at low concentrations (i.e., less than 0.2 pCi/g).

The ^{137}Cs contamination near the ground surface is probably the result of a surface spill of contaminated fluid. The origin of the ^{137}Cs and ^{60}Co contamination that is detected intermittently between 105 and 135 ft is unknown.

At depths between 232.0 and 233.5 ft a gamma energy peak near 186 keV is identified by the routine data processing methodology. The peak could represent ^{235}U that emits a gamma ray at 185.72 keV or ^{226}Ra that emits a gamma ray at 186.10 keV. On the basis of past logging experience with tank waste, ^{235}U is usually accompanied by a ^{238}U peak measured at 1001 keV (^{234m}Pa), which together represent processed uranium. In this borehole, counts are observed within the area of the 1001-keV peak, although not sufficient to statistically identify a peak using the routine processing methods. It is therefore possible that processed uranium contamination exists in the depth interval. Neither peak can be measured above its respective minimum detection limit and is not reported in plots. The ^{226}Ra gamma ray is rarely detected using a counting time of 100 seconds and is considered less likely than ^{235}U to be measured. If the borehole is logged in the future, a longer counting time should be used within this interval to provide better counting statistics.

The depths between 230 and 250 ft where ^{137}Cs, ^{60}Co, and possibly processed uranium contamination is detected coincides with the historical water levels. The depth to water has been reported as 242 ft in June 1956 and 231.9 ft in April 1990. Current log data indicate water does not exist in this borehole. An injection/reverse well is located approximately 15 ft southeast of this borehole and liquid effluent injected into the well likely caused a mound of water that has since receded, leaving contaminated soils in the vicinity.

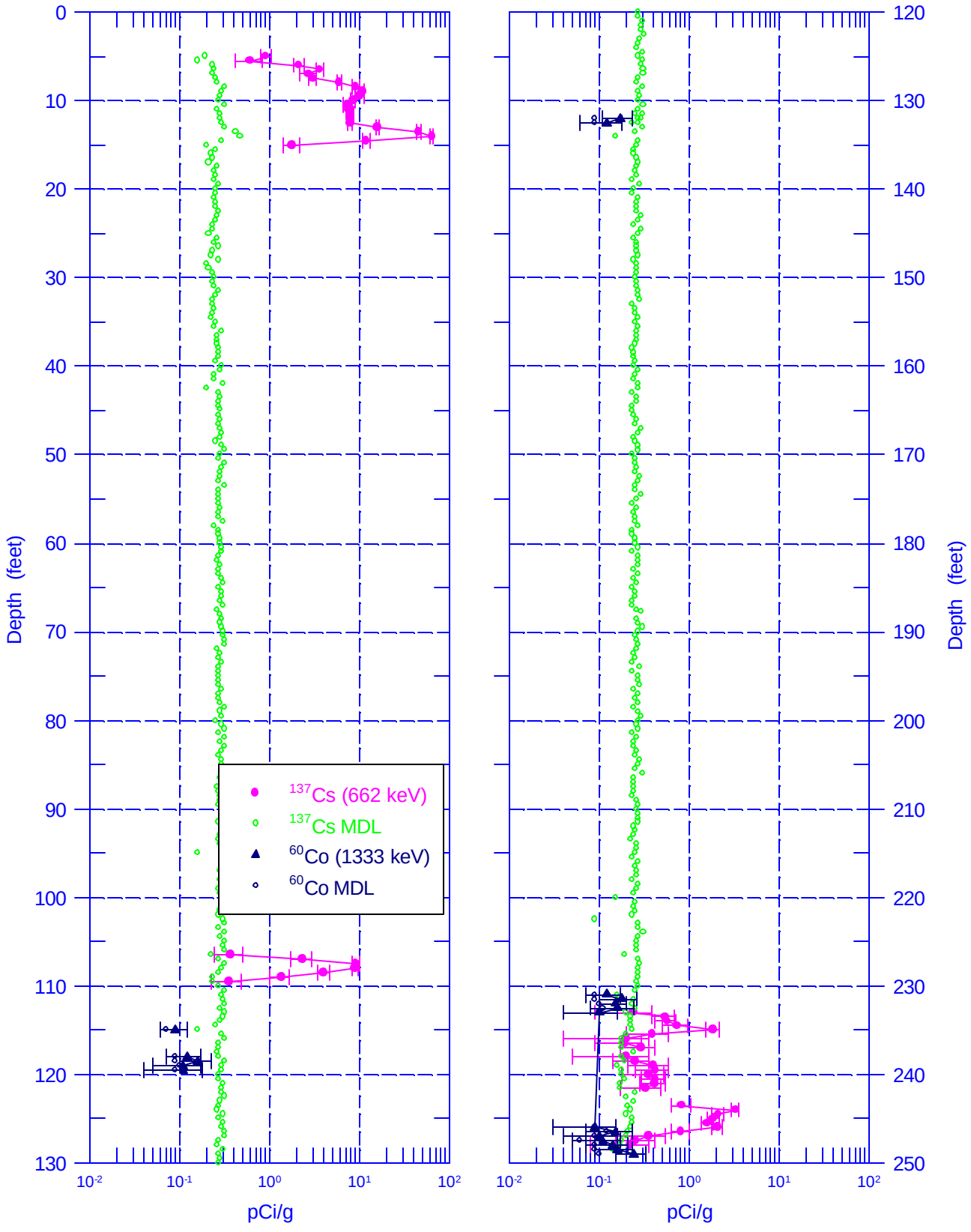
During log run 2 (35.5 to 132.5 ft), it is apparent radon (^{222}Rn) gas influenced the calculated ^{238}U concentrations. The repeat log plots (35.5 to 61.5 ft) show an enhanced ^{238}U concentration as measured by the 609-keV ^{214}Bi energy peak in log run 2 relative to that measured in log run 3 on the next day. Other ^{214}Bi peaks (e.g., 1764 and 1120 keV) that have lower yields relative to the 609-keV peak also exhibit enhanced count rates. In addition, the 351- and 295-keV gamma rays that originate from the decay of ^{214}Pb (second decay product after ^{222}Rn in the uranium decay series) exhibit enhanced count rates where elevated ^{222}Rn is suspected. The 295-keV gamma energy line is not generally detected in spectra with counting times of 100 seconds. Gamma energy lines emitted by isotopes that occur before ^{222}Rn in the decay chain do not exhibit enhanced count rates further suggesting the cause of elevated ^{238}U concentrations is the result of an influx of radon. The enhanced count rates of the peaks mentioned above, in addition to other associated minor peaks, contribute to a total gamma count rate that is higher in log run 2 than in log run 3 where the ^{222}Rn has apparently dissipated from the borehole.

The KUT concentrations generally do not exhibit sufficient change such that distinct litholgic units can be identified. An exception to this observation is the interval between about 221 and 237 ft where enhanced KUT concentrations are noted that are separated by an interval of lesser concentrations. These intervals are most notably observed in the total gamma log and could be useful to correlate lithology between boreholes.

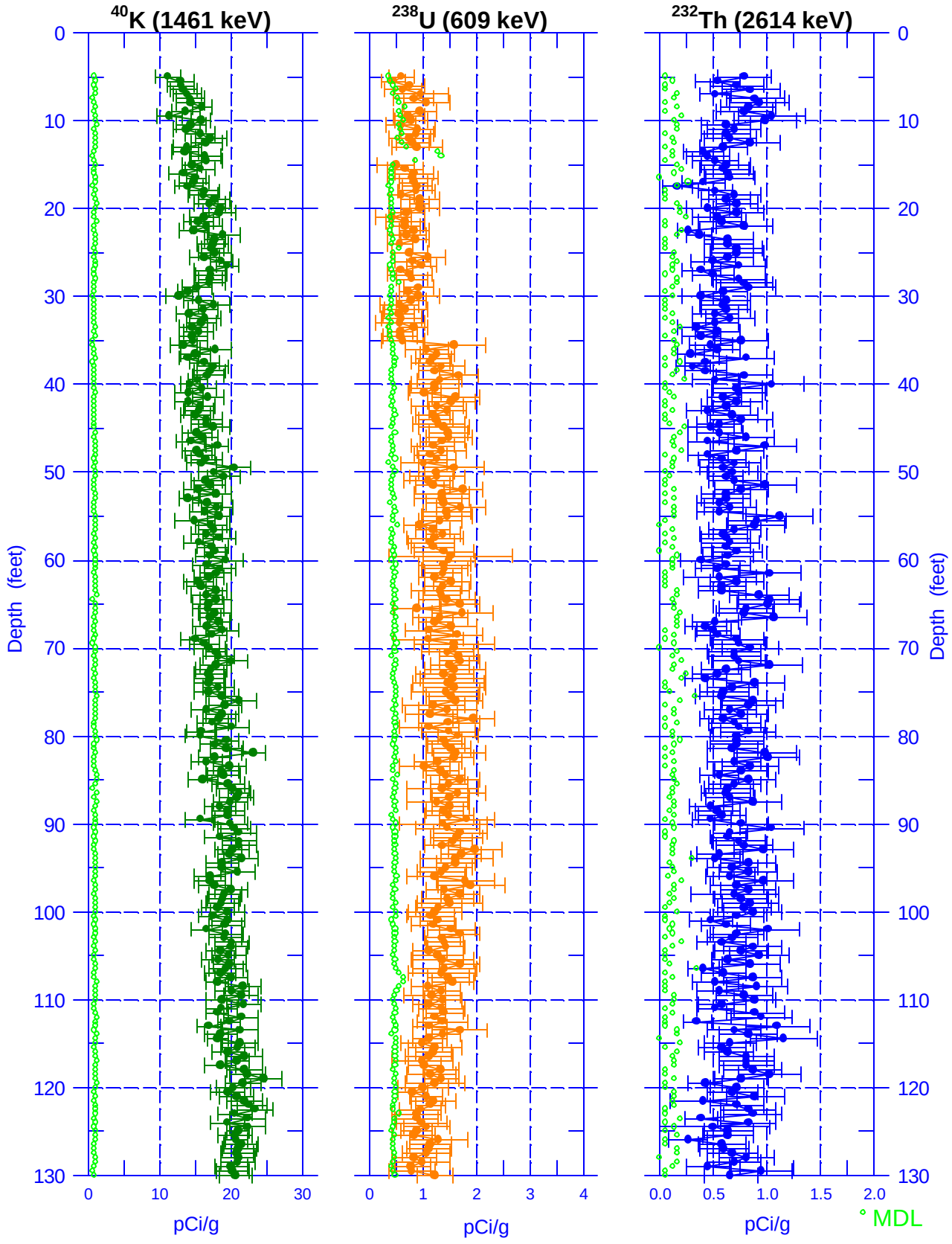
[1] GWL – groundwater level
[2] TOC – top of casing

299-E33-19

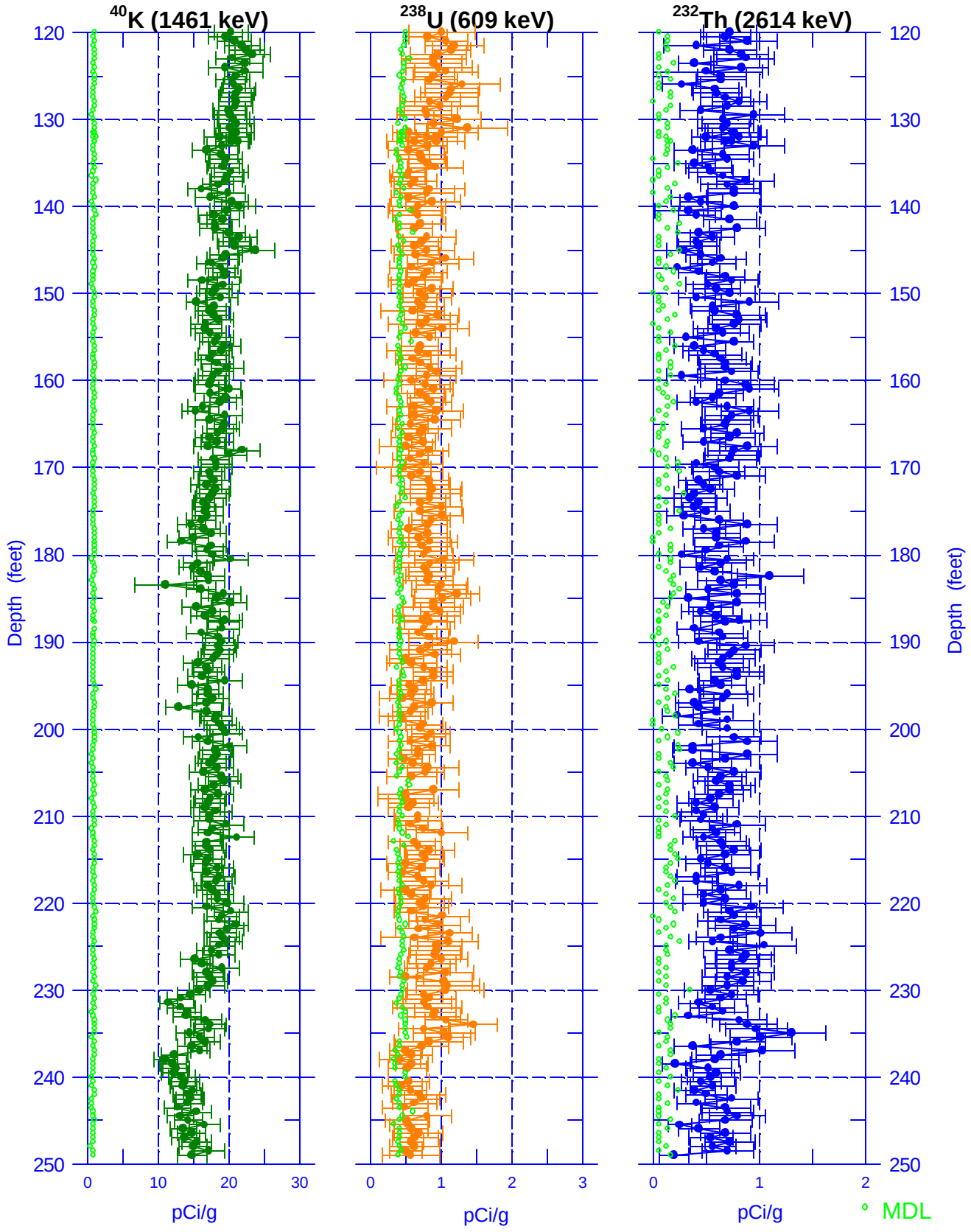
Man-Made Radionuclide Concentrations



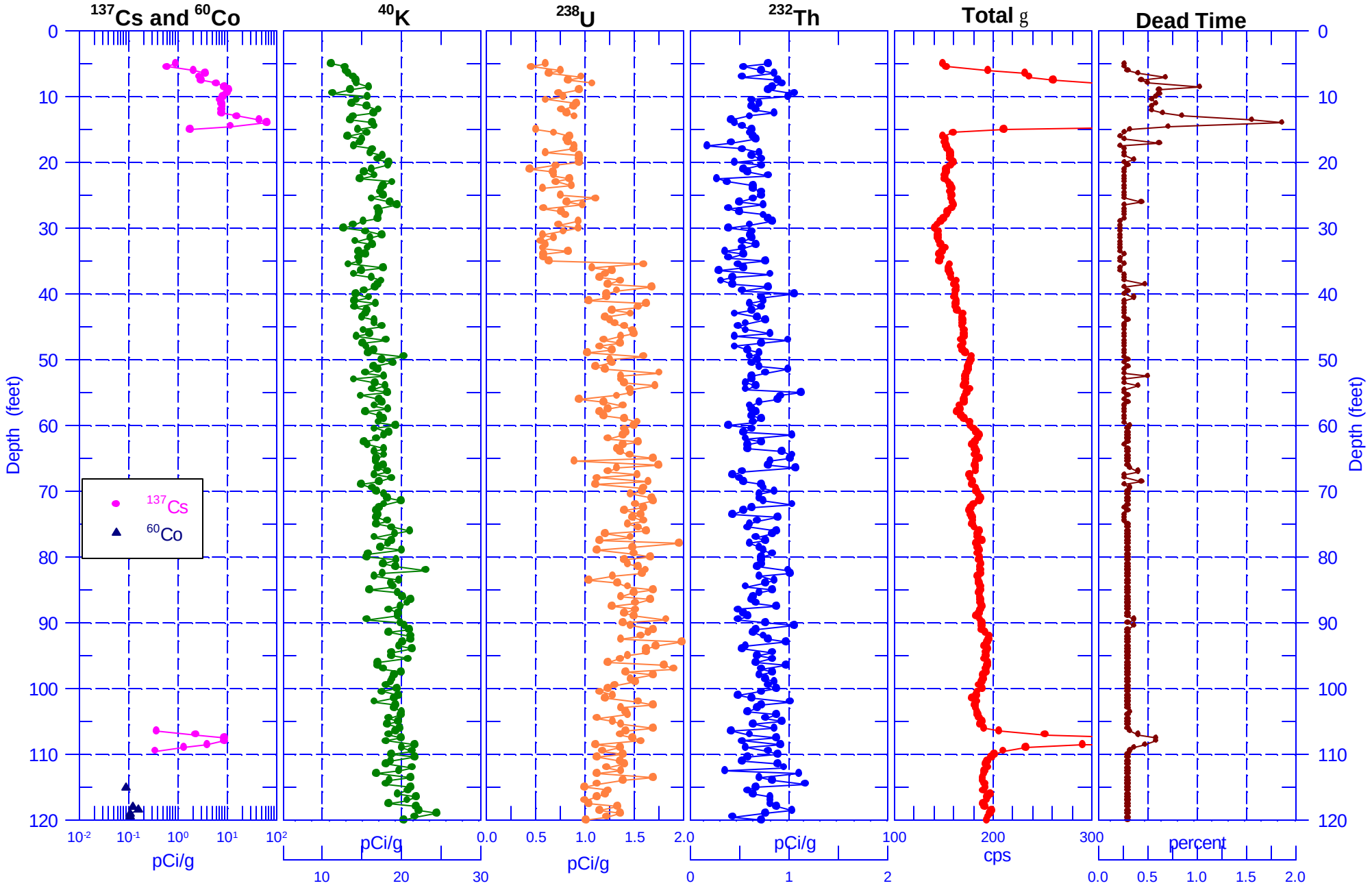
299-E33-19
Natural Gamma Logs



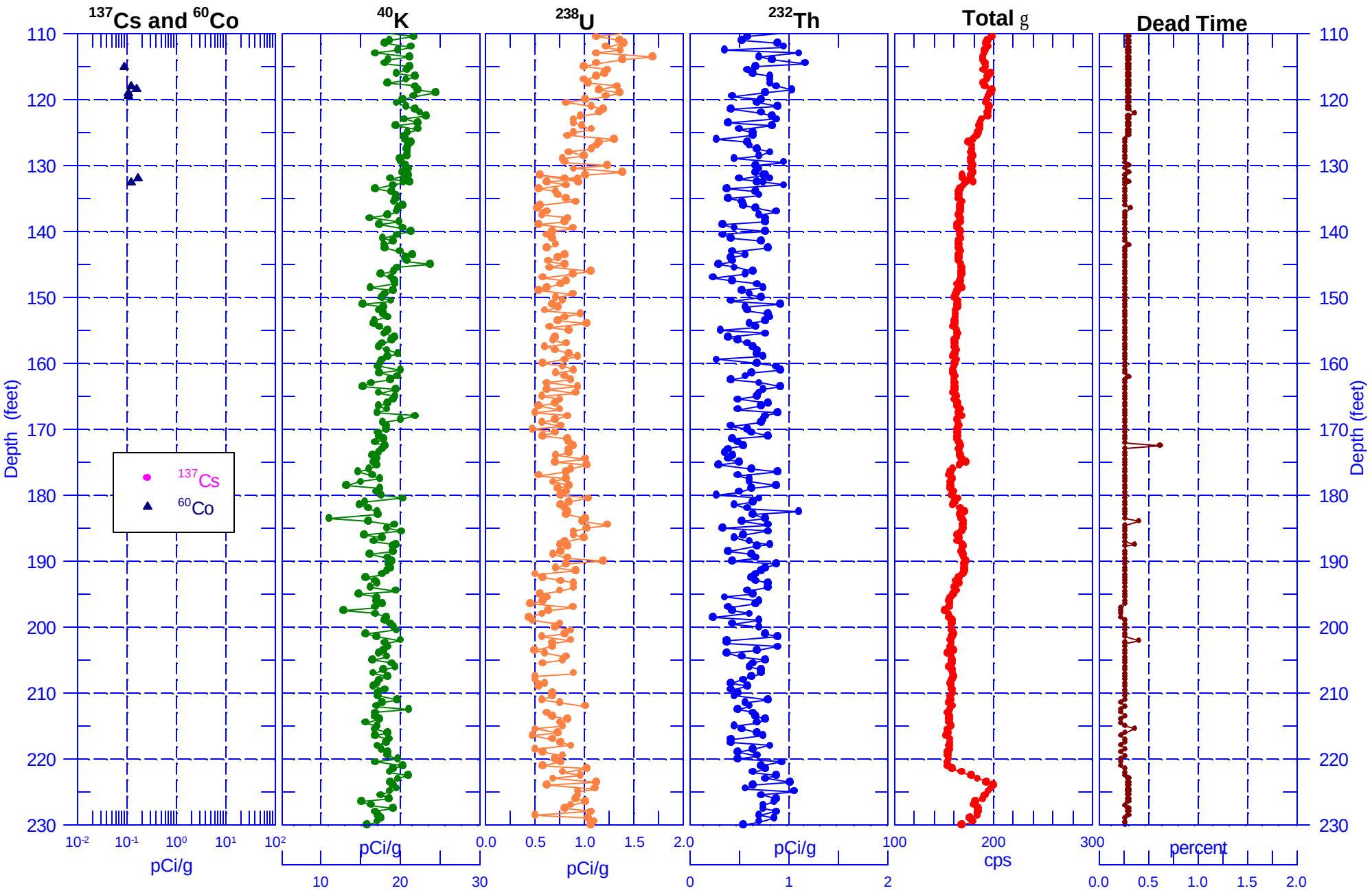
299-E33-19
Natural Gamma Logs



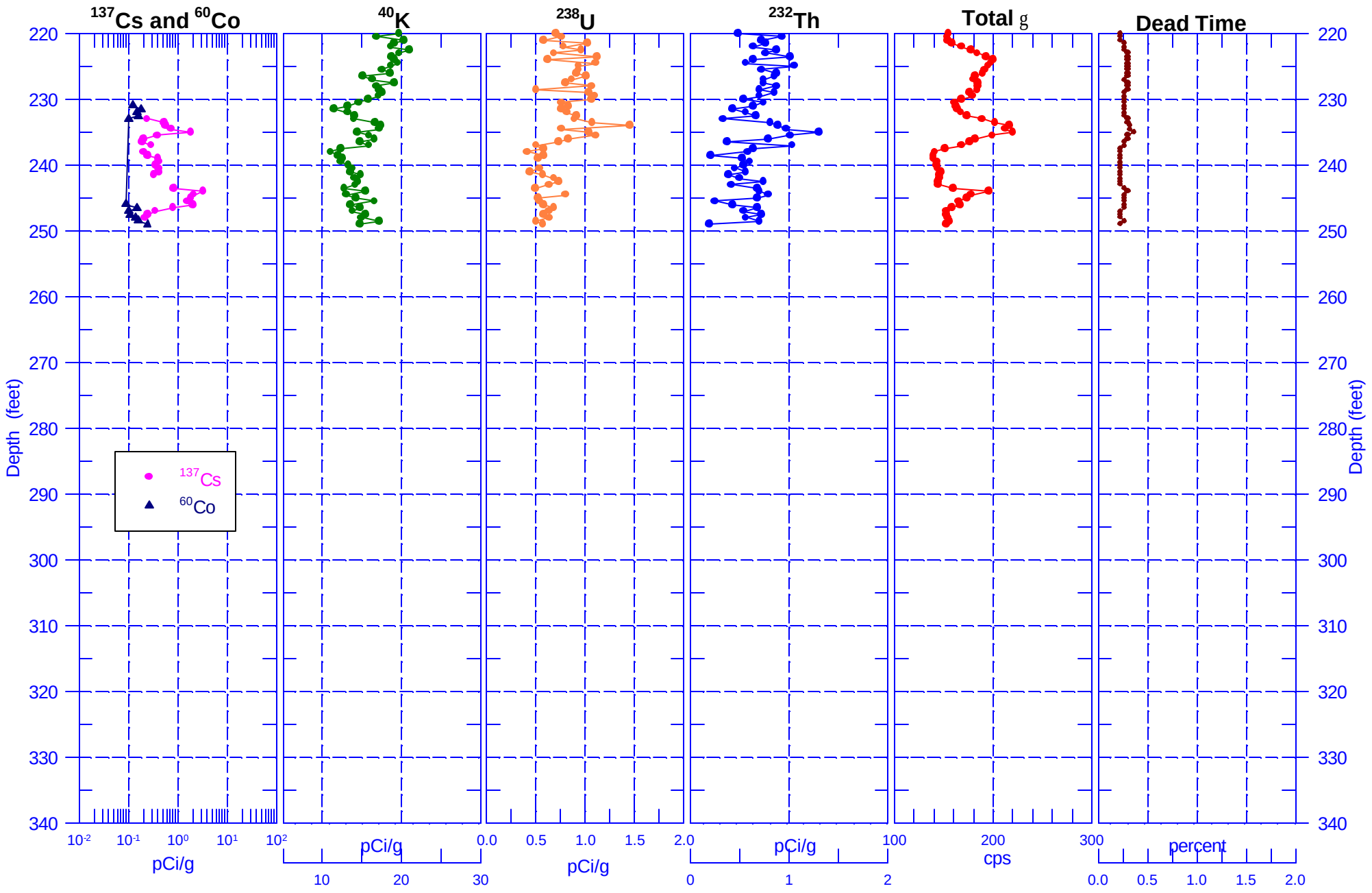
299-E33-19 Combination Plot



299-E33-19 Combination Plot

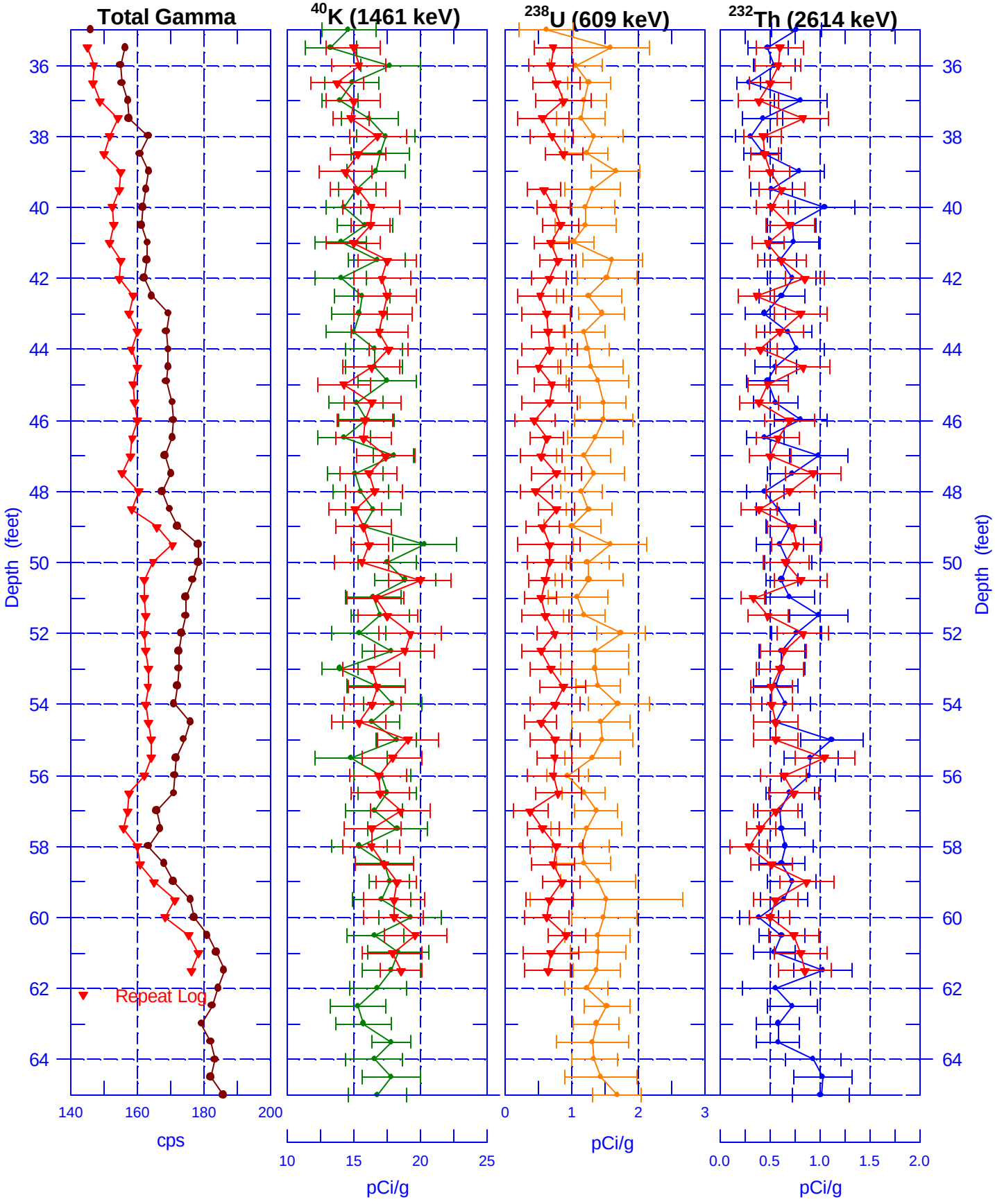


299-E33-19 Combination Plot

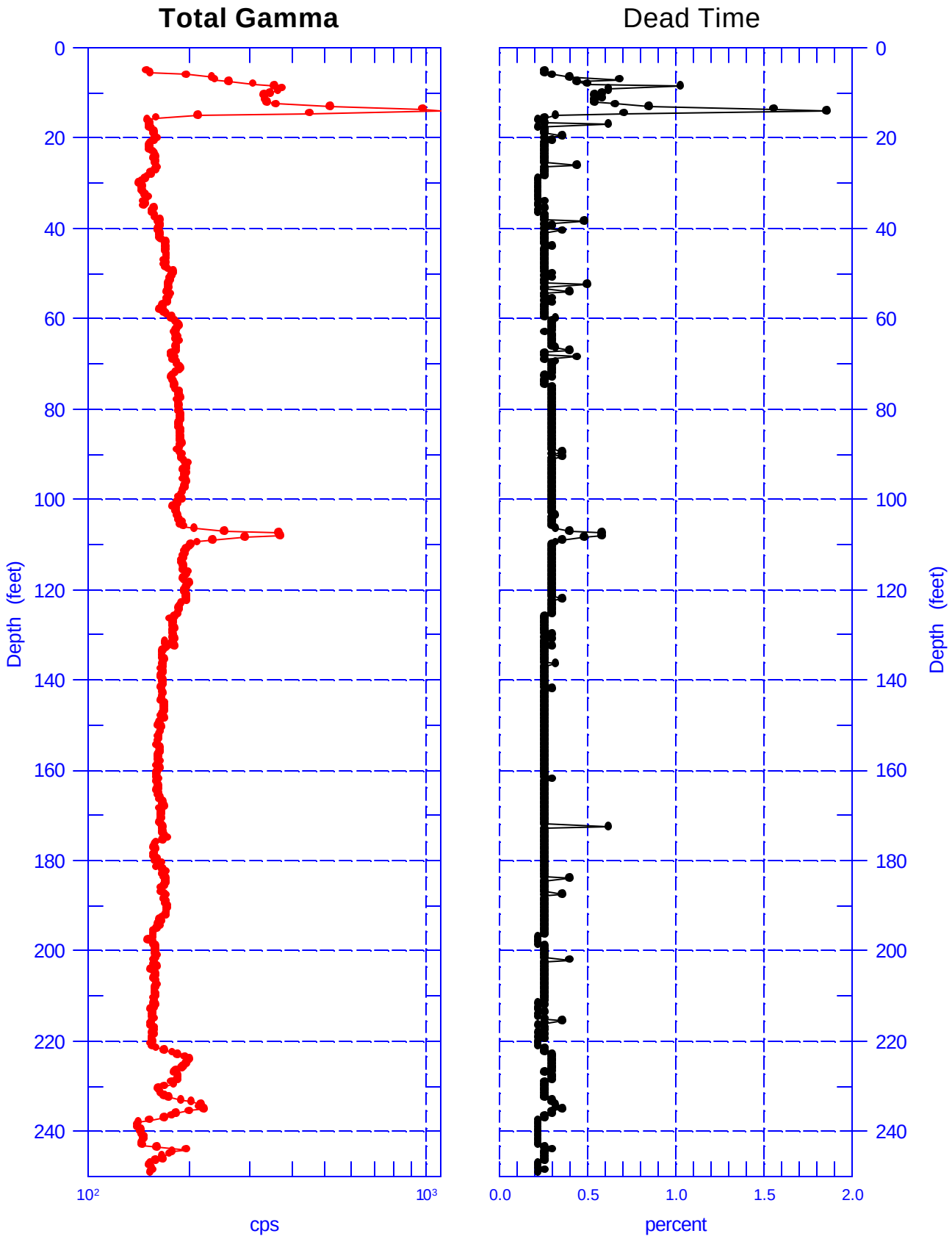


299-E33-19

Repeat Logs



299-E33-19


Total Gamma
Dead Time
0
20
40
60
80
100
120
140
160
180
200
220
240
Depth (feet)
10^2
10^3
cps
0.0
0.5
1.0
1.5
2.0
percent